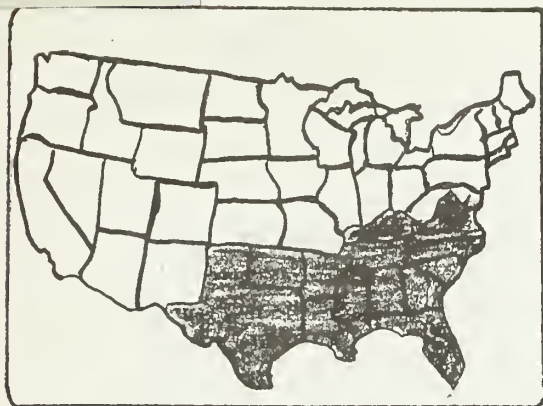


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A
Program of Research
for the
Southern Region
in

FOOD AND NUTRITION

Prepared by a

Joint Task Force of the
Southern Agricultural Experiment Station Directors
and the
U. S. Department of Agriculture

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FOREWORD

This report represents a continuing phase of the comprehensive planning of research by the State Agriculture Experiment Stations and the United States Department of Agriculture. The document was prepared by a task force assembled by Dr. S. J. Ritchey, representing the Directors of the State Agricultural Experiment Stations in the Southern Region, and Dr. Mary E. Carter, representing the Agricultural Research Service.

This report represents the collective judgment of scientists from different agencies and having rather diverse backgrounds. The task force was given the responsibility for recommending realistic guidelines for research in Food and Nutrition in the Southern Region. The Task Force has attempted to update the previous report and to relate the regional report to the National Program of Research for Agriculture, to the National Program of Research for Food and Nutrition, and to other regional research areas.

Members of the task force hope that the report will be a valuable contribution to research planning. The final effectiveness of the report can be judged by its usefulness to research administrators, particularly those in the Southern Region, and by its impact on research in food and nutrition.

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November 1975

THE TASK FORCE

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Introduction

This report, Foods and Nutrition Research for the Southern Region, emphasizes the continuing need for research in foods and nutrition. The Task Force attempted to update the previous report which was published in 1970 and to focus on regional problems. However, many of the problems are national in scope and cannot be isolated to the region.

Nutrition can be defined as the science that interprets the relationship of food to the functioning of the living organism. This definition provides some insight into the nature of nutrition and food science and indicates reasons for nutrition being diffused into several different areas of a land-grant university. The fact that nutrition has not been established as a separate administrative unit in many institutions, including the experiment stations, has led in many cases to fragmented programs and in other cases, to no identifiable program. The Task Force attempted to confine its report and recommendations to human nutrition and health, although significant amounts of nutrition research done in other academic departments has relevance for human nutrition.

Food science is a relatively new discipline. At one time most of the foods research was accomplished in home economics or in departments of foods and nutrition. At the present time, most of the food research and training is centered in departments of food science and technology. However, food research related to the properties and quality of food as served in the home or in a food service operation seems best suited for departments of foods and nutrition. Obviously, the particular

administration unit should be established to meet the specific requirements of individual stations and institutions. Clear separation of nutrition and food science would not seem realistic as long as man depends upon food as a source of nutrients and derives pleasure from food. Close cooperation between departments of food science and technology and departments of foods and nutrition seems paramount to the most rigorous program and for the most efficient utilization of institutional resources.

Foods and nutrition research was defined by the task force to include research on foods with emphasis on those aspects related to the home and institutional preparation, purchasing and consumption of the product, and research in nutrition as related to the health of the human. The task force recognized that the evaluation and projected needs of research programs alone would be futile. Other major factors must be considered since these secondary factors could be the limiting ones in building outstanding programs. One of the obvious factors is the manpower, the number of graduates coming from institutions in the Southern Region. Important also to research programs are facilities, regional research and the relative priority given to food and nutrition work. The range of problems related to research programs in foods and nutrition made close examination of the total impossible. The task force hopes that the ideas generated by those reading and using this report will enrich programs at individual institutions.

Background

Following the discovery of the major nutrients and the near disappearance of deficiency diseases in this country nutrition received

less attention than it had previously. In the minds of many, including numerous research administrators, nutrition problems had been solved. However, recent events have served to revive interest in nutritional science. These events have included the push by social action groups for the relief of hunger, the national nutrition survey which spotted widespread nutritional deficiencies among the affluent as well as the poor, U.S.D.A. studies that indicated a decline in the nutritive value of diets, and the White House Conference on Food, Nutrition and Health. While the demise of nutrition programs has not been confined to the Southern Region, neither has the region continued to promote nutrition. Specific examples of once excellent research and teaching programs, now dead, can be cited to support this point.

From the later part of the 1960's through the present time, general recognition has been given to the fact that nutrition problems exist within the United States and in the Southern Region. The White House Conference on Food, Nutrition and Health highlighted the situation in the minds of the public, but prior to this conference scientists, extension workers, government agencies, the news media and others were focusing attention on the serious nutrition problems within our country. The U. S. Department of Agriculture and the state agricultural experiment stations and extension services have taken the lead in dealing with many of the problems associated with proper nutrition.

Complex causes are contributing to malnutrition and hunger within the U. S. A large number of people lack an adequate knowledge about nutrition. Others fail to practice good nutrition, probably because they fail to see a close association between nutrition and health.

Many people have neither adequate incomes to purchase the food required for an adequate diet, nor is the food or purchasing power to obtain food available to them through the various government food programs. While we have a large bank of knowledge about human nutrition and our food supply, it must be recognized that there is a great need for intensified research and development in order to permit us to feed people adequately.

Many leaders in this country have stated that every person should have the advantage of a daily diet that is adequate and nutritious. If this goal is going to be achieved in the South, as well as in other regions, a major research effort will be required. A projection of the problems and the potential solution is necessary.

The Southern Region

Dietary levels within our country worsened from 1955 to 1965 (USDA, HFCS Rept. No. 6). However, the South showed the least overall decline in diet quality (USDA, HFCS Rept. No. 9). Similar surveys would undoubtedly show the diets to be about the same now as it was in 1965. A number of developments have contributed to the less favorable nutritional status of the population today than in 1955.

In the South, the proportion of families living on the farm declined from approximately 25 percent in 1950 to 10 percent in 1960 and is probably not more than 5 percent today. As a result of this shift, families obtain much less of their food supply from home production. Families moving from the farm to urban areas change their food habits. There has been a marked reduction in the use of milk, eggs, fruits and vegetables and grains and cereals. This accounts for some of the low

nutrient intakes, especially for calcium, iron, vitamins A, C, thiamine and riboflavin. The South has a higher consumption of fats and oil, flour and cereal, and sugar and sweets than other regions.

The Southern Region has a large number of families with low incomes and poor nutritional status. The disproportionately higher incidence of high blood pressure and hypertension in the Southeast, the high incidences of dental caries and tooth decay and the trend toward high intakes of over-cooked, deep fat-fried foods and the consumption of "greens" are unique to the region. Nutrition research should given considerable attention to those particular problems.

Outstanding research and graduate programs in food and nutrition at colleges and universities are scarce. Solution to the practical problems confronting the population depends, in significant measure, on research and education programs. These require manpower and dollars.

In reviewing changes in nutrition and food research in the region since the previous report, the Task Force was disappointed that the inputs into these important areas have not been particularly noteworthy.

The task force has mentioned numerous problems. Yet the hope is prevalent that our ideas and recommendations are realistic. Moreover, there is the hope that significant improvements in research programs in foods and nutrition will be generated by this effort.

NUTRITION--PRACTICES, FOOD HABITS, EDUCATION, STATUS

Nutritionally inadequate food consumption still prevails among a high proportion of the American people, despite increasing consumer purchasing power. Nutritional problems are apt to be intensified among middle and lower income families with inflation, increased unemployment,

rising costs of food and lack of knowledge of new developments in securing good nutrition making the problem for low-income families more acute. Although the agricultural experiment stations are not responsible for food programs and nutrition education of the general population, they are responsible for research to support present and future programs.

In the Southern Region malnutrition seems to be a problem among some low-income families, but evidence showing this to be a major problem is limited. Action programs combined with and based upon sound research are required for solution to present nutrition problems in the region. Major research needs are:

1. Identification of Problem Areas and Target Groups

Nutritional status varies among different economic, ethnic, sex, and age groups. Previous work has focused on the needs of preadolescents and young adults, however, there is still a need to study groups vulnerable to nutritional stress.

Research on pregnant women, infants, preschool children, and the elderly from low-income families should be initiated immediately to provide basic information for action programs.

2. How Food Patterns Are Formed

In order to make recommendations for improving the nutritional status of a population, it is necessary to learn how food patterns are developed. Information is needed on how ethnic background, income, nutrition knowledge, and level of education influence food choices. This is the background for developing food habits that fit the nutrition needs and life style of the family. As various family members regularly consume meals outside the home, there is a need to know the

role of restaurants, schools, and other sources of ready-to-eat foods in the total diet. The effect of advertising, mass communication, labeling (effectiveness of nutrient labeling), and packaging on the use of food products needs further study. A multi-disciplinary approach is required to gather this information. Nutritionists and food economists, along with social scientists, food scientists and practitioners must be involved. These problems are complex and require a long-term approach.

3. How Food Patterns Are Changed

An effective nutrition intervention program must deal with proper food attitudes and habits as well as pertinent nutrition information. Major changes in life style in the past decade have had an impact on food habits--increased numbers of working women and a more rapid pace of life have changed attitudes about what is prepared at home, number of meals away from home, and who eats together. Federal food assistance programs, the development of new food products, promotion of so called "health foods", the desire for weight control, and uncertainty about the wholesomeness of our present food supply have also affected food habits and patterns. There is a need to evaluate the acceptance of nutrition education and assistance programs by the people.

A. Testing of Nutrition Educational Methods

Land-grant institutions (including the 1890 schools) have long been involved in education programs of the rural and, more recently, of the urban population, particularly

as applied to food production techniques and family life. Extension programs are geared to this goal. Nutrition education has, from a realistic viewpoint, failed to reach many who most need help, particularly in the very low-income groups.

Nutritionists should investigate the effectiveness of various educational methods, especially with middle to low-income groups. Innovative approaches should be encouraged by administrators in both research and extension.

B. Evaluation of Existing Nutrition Programs

Federal and state governments spend huge sums on feeding or supplying the means for buying food for children, mothers, infants, and the elderly. We believe that these programs are worthwhile; however, there is a need for specific evidence of their effectiveness in promoting good nutritional health. Such an evaluation would use a combination of the existing methods--demographic, physical, clinical, biochemical, and psychological--plus the development of new ones.

C. Measurement of Ability to Change Food Habits

Since values represent the ultimate reasons for the actions of people, changes in food habits might necessitate changes in values. Research is needed to determine the potential capacity of groups to alter their values and to be receptive to new food patterns.

4. Evaluation of Nutritional Health

Additional critical parameters are required to evaluate the

nutritional health of human populations. Nutrition surveys are required for evaluation purposes, but carefully controlled laboratory and field studies are needed to improve and refine present techniques, to define new measures, and to establish realistic criteria for optimum nutritional health.

FOOD SERVICE SYSTEMS

The rapid growth and critical need for research support for food service systems is readily apparent on the local, state and federal levels as evidenced by the U. S. Department of Commerce estimate of 8404.9 million sales value for "Eating and Drinking Places in the Southern Region in 1973¹." Convenience foods, prepared meals and meals away from home have brought about changes in the eating patterns of most families. Food Services are an essential part of the tourist business in the southern region. Travelers in the South (11 states) spent \$12.5 billion or 24% of the national total spent on domestic short and long trips in 1973. Three out of four persons on long trips spent money for food. On short trips the ratio was one in two. Tourists' spending in restaurants accounted for a third of sales in eating and drinking places. Meals and beverages purchased away from home amounted to \$34 billion in the U.S.A. in 1973. The average family spent \$245.56 for food away from home in 1973². In the South, total sales in eating and drinking places amounted to \$5448.00 million or 16% of the total expenditures for food away from home in the U.S.A.

¹Code 58, U. S. Dept. of Commerce News, from Food Processing, Distribution & Acceptance, A Program of Research for the Southern Region. Nov., 1974.

²Copeland, L. 1973. Food and Food Services in the Nation's Economy. (Unpublished survey).

The food service and lodging industry constitutes one of the largest and fastest growing industries in the U. S. The "U. S. Industrial Outlook 1972" reports 3,076,000 employees in food service and lodging establishments in 1970. Manpower needs for 1980 were projected to be 5,419,000 or an increase of 76.2%. To meet the increasing demands of mass feeding, the food service industry is looking toward the centralized processing and distributing concept.

Food service systems are concerned with effective and efficient utilization of management resources in the delivery of food for direct human consumption, such as in schools and colleges, hospitals, day care centers, programs for the elderly, restaurants and the tourist industry. The magnitude and the growing importance of the food service industry is presented in Table I from the publication "Food Processing, Distribution & Acceptance", prepared by another task force of the Southern Region.

Table I. Eating and Drinking Places in the Southern Region¹

State	Establishments (Number)	Paid Employees for Week Including March 12, 1972 (Thousands)	Payroll Entire Year (Million \$)	Sales (Million \$)
Alabama	2917	26.5	72.6	346.0
Arkansas	2081	14.9	38.5	184.5
Florida	9762	132.0	392.6	1790.7
Georgia	4346	50.2	157.3	724.9
Kentucky	2952	31.8	88.9	418.3
Louisiana	4074	34.4	106.7	482.1
Mississippi	1943	13.7	36.6	174.0
North Carolina	4790	44.0	137.2	625.5
Oklahoma	3433	31.1	79.1	353.9
South Carolina	2248	22.5	63.9	301.6
Tennessee	4413	38.9	112.5	521.5
Texas	14081	137.9	408.6	1848.3
Virginia	4068	48.4	148.0	633.6
TOTAL	61108	626.3	1571.8	8404.9

¹Code 58, U. S. Department of Commerce News

The food service industry is becoming increasingly important in the delivery of the abundant supply of food produced by American agriculture, supplementing and replacing the preparation of food in the home. This segment of the food production system has the objectives of continuing to supply the American consumer with the most nutritionally desirable and wholesome food using efficient, economical and effective management resources.

The objective of the food service system is to provide food, whether it be snacks or complete meals, in wholesome, acceptable form, supplying the maximum nutritive value as economically as possible. However, the means of attaining these objectives, and the assurance to the consumer that these objectives will be accomplished, are not adequately defined. Research effort will be required to provide the necessary information. The following areas and targets for needed research have been identified:

1. Production and Service of Food in Volume

- A. Quality Control of Quantity Food Production

1. Establishment of acceptable consumer standards for food texture, flavor, color, nutritive value and microbial safety.
 2. Development of methods for measurement of these standards.
 3. Development of methods for achieving the standards through control of food safety, storage conditions, food processing and packaging, distribution and transportation, holding and service of food.

As centralization of food manufacturing takes place, quality control becomes more important due to the larger numbers of people being served and more difficult due to

consequent delayed distribution and service of the food to the consumer who is far removed from the production area. Centralization of food preparation necessitates the holding, temporary storage and transportation of food either in bulk or individual portions to satellite distribution and service units.

The factors in the physical environment where the food is held must be identified and the interrelationships of these factors with food quality must be determined so that realistic control of quality can be achieved through automated and computerized methods. An interdisciplinary approach involving food science, food service systems and mechanical engineering is required to determine the optimal time, temperature, moisture content, air velocity and relative humidity required for preparing and holding foods in quantity in order to preserve quality, nutritive value and microbial safety over extended periods of time.

Research is needed on methods of food preparation, particularly with respect to vegetable processing, to improve the acceptability of the processed product. The mechanisms of heat and cold transfer through food products should be elucidated to improve the various methods of heat application, including micro-wave. These studies should include the biochemical changes which occur during the holding period of prepared foods in order to more fully understand the processes which contribute to deterioration in taste, appearance, and sensory evaluation of those foods.

Continued work is needed in formulating new and faster methods of determining the presence of food-borne diseases in food at the point of distribution. Outbreaks of illnesses, commonly attributable to foods, are caused by poor sanitation during the manufacturing, holding and serving of food and could be avoided.

B. Relationship of the Physical Environment to the Acceptability of Food

The effect of varying types of lighting, noise levels and other environmental conditions on the acceptability of foods by individuals and groups of people needs to be studied. Special groups such as the handicapped and elderly could be studied in efforts to establish optimal conditions for serving food to these people.

Methodology to determine food acceptance by all segments of the population will require interdisciplinary research involving specialists in nutrition, food science, food systems administration, behavioral sciences, and education. The research should result in the formulation of quantitative and qualitative indicators and the development of mathematical models to study preferences for foods and favorable environmental conditions. There is a great need for data on the emotional, psychological and nutritional effects of the various services provided by food systems to individuals in hospitals, nursing homes, colleges and schools.

2. Quantitative Methods to Control Management Resources

- A. To identify the essential variables required to evaluate equipment needs in relation to the types of foods purchased (maintenance, down-time, percent utilization).
- B. To identify the essential variables required to evaluate labor needs in relation to the types of foods purchased (skill levels required, production time, planning, cooking and/or cooling portioning).
- C. To identify the essential variables required to evaluate effective use of time in relation to the types of foods purchased (elimination of peak activity periods).
- D. To identify the essential variables required to evaluate space needs in relation to the types of food purchased (storage, production).

Recent surveys of the types of foods being purchased by all segments of the food service industry indicate a steady trend toward the purchase of partially and ready prepared foods. As the trend continues, there is an increasing need for the management of these systems to know to what extent the degree of preparation of these purchased foods influence the other resources of management such as labor, space, equipment, and time.

Development of methods for studying a system and the interrelationships of its components could be invaluable to a manager in the decision making process. To develop suitable methodology, the essential variables of each of the management

resources to be studied must be identified and evaluated in relation to the type of food purchased.

3. Manpower Training for Food Service Systems

- A. Development of short range training programs to meet the problems related to rapid labor turnover in food service systems.
- B. Development of effective long range training programs to meet the changing needs of the food service systems and provide a means for personnel to advance to higher levels in the organization.

Unexpected, rapid turnover of food handlers, particularly in the fast food segment of the industry, requires on-the-job training if breakdowns in food safety are to be avoided.

This requires the development of training programs specifically for instruction in the elementary principles of food handling and personal hygiene.

Present and future training and employment requirements in all areas of the food service industry must be identified and skill-levels determined to better prepare personnel in the industry for more efficient and effective performance on the job. When these basic labor needs are determined, multi-disciplinary research, utilizing the social sciences, should determine variables such as attributes and personal characteristics desired at each skill-level in conjunction with the degree of intellectual development required. Variables such as these, once established would form the guidelines for recruitment of personnel. A study of the characteristics of

the labor market available to the food industry would be the basis for the design of training programs to provide the required skills.

4. Design of Efficient and Effective Food Service Systems Facilities

Rapidly changing food processing methods and availability in the market of convenience foods, ready foods, and prepared, frozen food products ready to heat and serve, have radically affected the design of food service equipment and facilities. Decision models need to be developed for use in determining space and equipment relationships based on the forms of foods purchased and specific operational needs of the food service.

Research in food service systems is critical to food distribution systems of agricultural products and consumer satisfaction and well-being. Food service operations apply knowledge in the areas of food, nutrition and microbiology to the feeding of many groups of people. If food supplies become a limited national or world political commodity, food service systems will play a critical part in the efficient and effective distribution of foods which provide minimal nutritive values for existence to groups of people.

FOOD QUALITY AND PRODUCT DEVELOPMENT

Changes have occurred in the available food supply of the nation and the region. Many of the foods used in greatest quantities have been affected. There is a continuing increase in the proportion of the foods purchased that are in processed form. Convenience foods are in demand. In some cases the nutritional value of the convenience

form of the product may be as good and the cost as economical as the fresh product (e.g., frozen citrus concentrates). However, the same is not true for all processed products (e.g., processed potatoes have a reduced ascorbic acid content and an increased cost).

The increasing use of snack foods causes many people to fail to satisfy the Recommended Dietary Allowances. Snacks are particularly popular with the young people and children. In the South the consumption of soft drinks by young people is much greater than in other regions of the country while the consumption of milk and milk products is less. The consumption of items, such as potato chips, cookies and candy has increased. These foods probably have replaced other foods, such as milk, vegetables and fruits, which provided nutrients needed to achieve diets of good quality. Therefore, the high consumption of these products may have contributed to a decline in the quality of the diet. Fifty-five percent of the families in the South had good diets in 1955 but by 1965 this had dropped to 48 percent. This decrease was lower than for the Northeast and West but was the same as in the north central region. In addition, the proportion of poor diets in the South was slightly higher than any of the four major regions of the U. S.

Continued efforts to improve the quality, including flavor, color, texture, nutritional value and safety, must be exerted by researchers in food science and nutrition. The increased use of processed foods coupled with the feeding of larger numbers of the population through institutionalized food services places an additional burden on the food scientist. Research designed to maintain and even improve the

quality of the food supply from the time of harvest until final consumption is a major task. While many problems were discussed by the task force, the following were designated as major research needs:

1. Composition of Foods

Various health and social organizations, as well as government agencies, have been interested in the development of programs which can contribute to the improvement of the health of individuals. General recognition has been given to the need for the improvement of nutrition in a widespread segment of the population. The "Ten State Nutrition Survey" published by the U. S. Public Health Service in 1970 and the White House Conference on Food Nutrition and Health highlighted the problems of nutrition and the fact that frequently consumers do not make intelligent purchases of food. It is recognized that one of the contributory factors is the inadequacy of knowledge about the nutrient composition of foods. In order for the nutritional labeling regulations of the Food and Drug Administration and the U. S. Department of Agriculture to be utilized by industries for the benefit of consumers, a much greater bank of compositional data must be available. Some components found in foods can act as inhibitors to the biological availability of nutrients or may be deleterious factors. Frequently these components can be inactivated by heat or other processing techniques. Legumes are well established as a source of dietary protein. However, the deleterious effects of legumes are also well characterized and include the following categories:

hemagglutinins, natural toxins, goitrogens, cyanogenetic glycosides, and trypsin inhibitors.

The following approaches seem to have merit in solving the current problems:

- A. Obtain data on the nutrient composition of those foods for which current data are not available. The Consumer and Food Economics Institute, Agriculture Research Service, maintains a data bank and can serve as a reference base.
- B. Determine the change in nutrient composition of various foods resulting from processing procedures, storage, handling and distribution practices. Nutrient data should be obtained for the fresh food products and at all stages until utilized by the consumer. This will involve studies of nutrient composition as altered by:
 - (1) Differences in varieties.
 - (2) Stage of maturity.
 - (3) Harvesting, handling and storage conditions.
 - (4) Processing conditions and methods.
 - (5) Home preservation methods.
 - (6) Cooking, storage of leftover products and recooking.
 - (7) Presence of anti-nutrient factors or toxic materials.

2. Product Development and New Food Sources

The development of new low cost food items and foods designed for special dietary needs is becoming increasingly important because of higher retail costs of food, greater attention to obesity and higher fat contents of current diets, increased

use of food enrichment and/or fortification to raise nutrient quality of certain foods, and better technology for food production and processing. For example, as animal protein foods increase in price they become less available to lower income families, other sources, such as legumes, cereals, pulses, and oilseeds, are now being considered as substitutes, as well as potential extenders of protein foods. The Southern Region is most suited for the production of these crops.

Research is needed on these crops and potential crops to develop lower cost and new foods. The following approaches seem appropriate:

- A. Develop new products from existing food crops and from new food sources not presently considered major food commodities.
- B. Expand basic and applied research on the enrichment and/or fortification of present and newly developed foods.
- C. Develop processes to economically utilize waste products for foods.

3. Food Systems and Bioavailability

Agriculture - as have other industries - has changed considerably in recent decades and is expected to change more as we go into the next century. Fewer people are engaged in production but more people are engaged in processing, distribution and marketing of the thousands of new food items now available. These include convenience foods, snacks, low-calorie foods, baby and geriatric foods, synthetic foods and pet foods. This trend toward more processed foods in our diet has greatly increased our need for more information on the effects of

various processing methods on chemical interactions between components within a single food commodity and between components in mixtures of two or more commodities or food additives.

Certain types of processing and/or particular components in foods can decrease the bioavailability of other major (or minor) nutrients (e.g., phytic acid binding of iron or magnesium).

There is also a need to obtain more data on chemical and physical parameters in different crops that might be utilized in designating certain commodities from specific areas as more suitable for direct consumption or for processed foods.

Research is needed to develop sufficient data on chemical compositions of different food crops to be used in defining chemical and physical parameters in these crops for determining future use as direct or processed food items. The following approaches may be productive:

- A. Evaluate the nutrient composition and bioavailability of major nutrients before and after processing for any adverse effects of the processing methods employed.
- B. Examine the interactions between components (e.g., proteins, lipids, carbohydrates, minerals) in single and multiple food items for adverse effects caused by processing methods.
- C. Evaluate the bioavailability of selected nutrients (e.g., trace metals, essential amino acids) and their possible binding to antinutrients in foods as affected by processing methods.
- D. Determine the chemical compositions of the major crops, same varieties grown in several different areas, for

effects of growing conditions on certain nutrients.

E. From the data obtained on chemical composition of these crops, develop chemical and physical parameters that can be utilized in designating certain crops (from specific areas) as more suitable for direct food use or for processed foods.

4. Food Acceptability

Food acceptability is determined by a number of sensory factors and socio-culturally determined food habits. The focus of this problem concerns food acceptability based on sensory qualities, whereas the problem of sociocultural influences on food acceptability is discussed on page 6 of this report.

The factors influencing food acceptability begin with cultivation or breeding and continue through the steps of processing, handling, distribution, storage and final preparation for consumption. The environment, as well as the genetics, of the raw product may ultimately affect acceptability.

Acceptability is the key to success or failure of engineered foods. An example is the marketability of soy or whey-based drinks as alternatives to soft drink products. The Southeast Region presently ranks first in soft drink consumption. If the more nutritious soy or whey drinks are to become competitive with soft drinks, they must have an acceptable flavor and mouthfeel. The acceptability of simulated foods, such as meat extenders, is measured by the consumer in terms of likeness

to the product being simulated. If the deviation in flavor, texture, aroma and appearance is too great, the simulated products are not likely to be selected.

Acceptability and nutrition are also related. Food that is not acceptable is rarely consumed. Therefore, the nutrients of the unacceptable food are of little value.

The following research requires attention:

- A. Methods to minimize the loss of acceptability characteristics of foods as a result of processing, preservation, handling, distribution or storage.
- B. Selection of genetic and environmental factors of the raw product which enhance the acceptability of the food.
- C. Improvements in the acceptability of engineered foods that are valuable in extending the food supply.

Appropriate approaches to these problems include the identification of the component parts of flavor, aroma and texture which add to the understanding of their contributions to the acceptability of foods. This information may be utilized in the study of interactions during processing, storage, etc. or in the simulation of flavor, aroma, texture and appearance. All approaches to the investigation of food acceptability should include an integration of objective and sensory evaluation. Objective methods are valuable for determining composition and characteristics of food as measured by instrumental methods such as breaking strength, compressibility, etc. However, sensory evaluation is the only valid method for assessment of the total effect of the component parts on the human senses.

5. Information Requirements Relating to Shifts in Food Marketing

There are many factors that influence the marketing of foods and the decision of consumers to purchase or not to purchase particular food items. Among these are the cost of foods, availability, concerns for the potential effect on health with the use of some foods, and the promotion of foods by advertisers and special interest groups. When any of these factors have an impact on the decision of the consumer or the food industry to make shifts from the normal practices there are technological problems.

As a result of the rapid increase in sugar prices, many consumers and industries are using substitute sweeteners for sucrose. The physical and chemical properties of the substitutes are greatly different from sucrose and different technologies are required in utilizing the substitutes in products. The reduced availability and high cost of grains for livestock feed and the resulting increased cost of beef has encouraged the effort to replace some of the grain fed beef with grass fed beef in the markets. Undoubtedly the poor acceptance of grass fed beef has resulted, to a large extent, from inadequate information for the preparation of the products for consumption.

Currently, consumers are confronted with concerns for health as implied in questions the desirability of fiber in the normal diets, the safety of products containing nitrites, as well as many other questions raised about some foods and practices that have been accepted for many years. If changes

or adjustments are to be made from the use of many of the foods in the form they are presently marketed, then numerous technological innovations must be undertaken.

Important to research in this area are the development of methods for assessing the long term effects of new food ingredients, products and processes on the nutritional status and health of consumers. The level of particular food components, such as fiber and nitrites, on health should be determined. The best technological practices for utilizing new food ingredients or new types of foods merit considerable effort in the future.

The following research needs additional effort:

- A. The development of technologies required for the utilization of new or alternate food ingredients and new types of foods for the markets.
- B. The determination of the long-term effects on the nutritional status as well as other health parameters related to the use of particular foods and food ingredients.

6. Evaluation Methodology Used In Assessing Foods

Accurate and reliable evaluation methodology of foods is essential for investigations that build on current knowledge. The efficiency and sensitivity of physical, chemical and microbiological evaluations of foods have increased as a result of improved materials and instrumentation. Sensory evaluation methodology has improved as a result of a better understanding of the chemical, physical, and psychological factors affecting the senses of sight, sound, and smell.

Recent developments in food science dictate a reliable and efficient methodology. The analyses of trace nutrients and unintentional and intentional food additives present in small amounts require sensitive methods of assessment. Nutritional labeling on a large scale requires accurate and rapid methods of analysis. The predicted acceptability of new products is dependent upon accurate evaluation of the food before marketing. Finally evaluation methodology is a key to understanding the properties and reactions of foods through analysis of the components of the foods.

The assessment of methodology may require a more innovative approach than any other problem. Investigators must be pioneering in spirit and willing to try methods which have been used only on an entirely different food system. With a thorough understanding of the principles of the traditional methods, a more effective modification or entirely new method may evolve.

Critical tools to the study of methodology are appropriate statistical procedures and control of a model system or a standard. The approach to establishing accuracy and reliability require the control of replication and comparison of results obtained by different methods used to evaluate the same food.

Research areas requiring high priority are the following:

- A. The development of sensitive methods of analysis, especially for components normally present in trace amounts.
- B. The development of rapid methods of analysis with a minimum of preparation without sacrificing accuracy and reliability.

- C. The determination of relationships between physical, chemical and microbiological evaluation and sensory evaluation as useful predictors of quality.
- D. The development of methods which are not prohibitive in cost for equipment or time.

NUTRITION - METABOLISM AND UTILIZATION OF NUTRIENTS

Advances in nutritional sciences during recent years have greatly increased our knowledge about the role of nutrition to human health. Some of the many recent findings promise to establish important relationships between vitamin D metabolites and renal dysfunctions; others suggest that limited intakes of essential trace minerals are impeding the optimal health development of our youth and older adults; a complex of nutrient imbalances of trace minerals, decreased intakes of dietary fiber, as well as excessive intakes of fat, have recently been implicated in cardiovascular disease. These and similar breakthroughs in human nutrition have been largely realized through the development of new analytical techniques which permit the scientist to measure and evaluate the relative importance of nutrients and their metabolites derived from our foods. However, a myriad of important questions remain and require investigation. The Task Force examined the current information on the composition of food, and on the chemical and physical changes from ingestion through excretion, either unchanged or in the form of its metabolic end products. Influences that food or their metabolic products may have on the development, activation, or inhibition of vital metabolic processes were considered also.

1. Availability of Nutrients From Foods

Though considerable research has been accomplished, there should be continuing study of the availability of nutrients from foods as the sources and combinations of food continue to be altered. The following problems are important and researchable:

- A. Physical and chemical changes occurring during digestion and absorption. Changes in the food, the mixture of food, and the combinations of nutrients may all affect the utilization of nutrients.
- B. The relationship of nutrients to each other and to other compounds found in the food. Numerous relationships have been studied and found to have an effect on nutrient utilization. Examples are copper and zinc, protein and calcium, and calcium and phytates. Others remain to be elucidated.
- C. The availability of nutrients from plant and fermentation proteins. The predicted increasing utilization of plant proteins and proteins from new sources such as fermentation, makes it important that information be available on the biological values of these proteins and the factors which make up the protein biological value, such as digestibility, absorption, and utilization. The influence of processing is most important in the future as the possibility of significant shifts to plants as sources of essential nutrients is increasing.

2. Digestibility and Transport

The entry of food into the intestinal tract stimulates the production and the flow of enzymes. Certain of the hormonal relations are known. However, such knowledge is rudimentary in terms of our present concepts of biological phenomena and could stand further study at the cellular and molecular level. The digestibility and availability of critical nutrients from the host of new food products poses a need for continual evaluation in the normal subject.

There are a number of problems in the digestibility and use of nutrients in persons having diseases. Further knowledge is required as a basis for treatment and prevention of these diseases. Such diseases are: celiac disease and sprue, lactose intolerance and intestinal allergies.

The basic mechanisms involved in transport of nutrients across biological membranes is now under intensive investigation, and more nutritional biochemists should be directing their attention to this "transport" mechanism in their ongoing programs. Problems which merit particular attention are:

- A. Mechanism of absorption of nutrients across the intestinal mucosa. The mechanism of transport of nutrients across cell membranes is under intensive investigation as part of the general study of cell membrane structure and function. However, emphasis has been on the molecular structure of the membrane and on the so-called active transport, with little attention being paid to specific nutrients.

Attention should be directed toward those nutrients which are most critical to the health of the population.

- B. Mobilization of nutrients stored in tissues. Particular emphasis should be placed on the utilization of fat from adipose tissue.

3. Requirements of Nutrients for Health

The main thrust of past nutrition research has been directed toward the requirements of nutrients by various age and sex groups. But the information is far from complete and many current recommendations are based on a small number of subjects or have been extrapolated from literature data. Important examples requiring study are:

- A. The requirement for fat-soluble vitamins as related to the level of dietary polyunsaturated fatty acids. The recent USDA report that polyunsaturated fat in the diet aggravates the development of goiter in iodine deficient areas serves to emphasize the case.
- B. The role of saturated and unsaturated fatty acids in the diet has not been properly resolved from the viewpoint of biochemists and nutritionists. Most reports have been the product of clinical studies which were seriously uncontrolled, and certainly not at the mechanistic level. If saturated and unsaturated fatty acids control the levels of serum cholesterol concentration, the mechanism of such action must be clarified. Other long term effects of diets high in either saturated or polyunsaturated fatty acids must be elucidated.

- C. There is reason to think that the present standards of calcium requirement may be faulty. It has been standard procedure to determine nutrient requirements by balance studies. While this is reasonable it is also recognized that balance may be established at various levels of intake. The true levels of calcium requirement also need to be studied with respect to age, sex, and lactation.
- D. The amino acid requirements of the normal human subject are based on relatively few studies. The ratios of essential amino acids, the role of non-essential nitrogen, and the interrelationship of the various nitrogen components require detailed investigation. Adequate nutrition of the normal person forced to consume a mixture of plant proteins or diets of poor protein quality, as well as nutrition of the person afflicted with an error of metabolism involving an amino acid, must be based on knowledge of amino acid requirement and the role of other nitrogen components.
- E. Certain vitamins, such as vitamin A and folic acid, have little basis for their recommended allowances, though these nutrients are often implicated as "poor" in nutrition surveys.
- F. The trace elements have been given very little attention in the past. During recent years, several of these elements, including zinc, copper, and chromium, have been implicated in human diseases. Studies are needed to define

more clearly the physiological needs for trace elements of the human under different circumstances.

4. Role of Nutrition During the Life Cycle

Recent information has demonstrated a relationship, although certainly not defined clearly at this time, between nutrition and total development, including the physical and mental aspects, of the individual. Particular attention should be given to:

- A. Early Development. Adequate nourishment of the fetus and the newborn is essential for normal mental and physical development. The role of nutrients in the development of the hormonal and enzyme systems is almost completely unknown. Also, the role of nutrients consumed early in life as related to long-term development is not clear. For example, the potential for obesity may be acquired as a result of very early nutritional practices, but this has not been determined yet.
- B. Growth. The role of nutrients during growth and the relation of the growth period to general long-term health has not been adequately investigated. It is conceivable that individual differences in the response to dietary constituents may be acquired rather than genetic. Thus, the constant presence of one food element, or the deficiency of another, may result in an unusual tolerance to the former and intolerance to the latter, due to highly developed or underdeveloped enzyme systems. It is also of interest to know whether such differences are permanent or can be reversed.

C. Adult and Aging. The nutritional needs of the adult, particularly in the later years of life, require additional research. The entire subject of geriatric nutrition is a ripe field for nutritional and biochemical study. This may be of particular importance to the Southern Region because of the large population of persons who retire in the warm climate. Excellent opportunities for both field and metabolic research are present in the region.

5. Function of Nutrients

Current information about the functions of individual nutrients represent an imposing volume of knowledge. Yet, the biochemical or physiological roles of certain nutrients, some of the first to be classified as essential, are not known. Nutrients such as fluorine, vitamin K, certain micro-minerals and possibly others, have no clearly defined and specific role, yet are classified as essential to either man or a closely allied species. Certain other nutrients such as chromium, vanadium, and arsenic may have beneficial functions.

6. Nutrition and Risk Groups

Nutrition has been discussed in the foregoing sections from the view of metabolic and biochemical function and effect. There must, however, be a somewhat different approach to nutrition of the human subject if we are to fully comprehend all ramifications of nutrition and development. Studies on deficient subjects have been done in hospital metabolic units and in developing countries. There has been little effort in this

country to study the effects of nutrition or development in those population groups classified at high risk. Examples of these risk groups are:

- A. The Poor. Nutrition may be a limiting factor in the potential of this group, though the nature of nutrition defies placing an economic value on it.

Studies with this group must be carefully defined and controlled, should be long-term in nature, and should involve several different disciplines. Cooperative efforts between nutritionists, sociologists, psychologists, physicians, child developmentalists and others should be inherent in such research. At the same time, program based on socio-economic research can be devised to relieve the depressing conditions of environment which deter the child from attaining its full potential. Nutritionists in the Southern Region are in a good position to provide leadership for such research. Most are in close proximity to low-income groups and can work closely with allied professionals through their institution or experiment station. This seems to be a problem in which the expertise of personnel in both research and extension phases of the traditional land-grant institution could be mutually beneficial. The currently active regional project (S-87) is an example of work needed in this area.

- B. The Obese. This population group represents a significant percentage of the total population. Numerous health

problems, including cardiovascular maladies, the tendency to become diabetic, and physical ailments, seem to accompany the excess weight.

- C. The Elderly. This group has unique nutritional problems many of which are the result of poor health and nutrition practices over a long period of time. The elderly are confronted with unique social situations which affect their nutritional practices and health. Their specific nutritional needs are not well known, though there is general recognition of problems during aging.

MANPOWER PROJECTIONS

The National Program of Research for Agriculture, prepared in 1966 identified major problems areas and assigned priorities and manpower requirements to solve the problems. Recommended manpower increases by the National Program are summarized below by problem areas.

		<u>SMY in SAES and USDA</u>		
<u>Research Problem Area</u>		<u>1966</u>	<u>1972</u>	<u>1977</u>
RPA 703	Food Choices, Habits Consumption	26	29	34
RPA 704	Quality of Foods	25	25	25
RPA 708	Human Nutrition	142	254	294
Percent of National Program		1.84	2.14	1.92

The National Food and Nutrition Task Force examined carefully these recommendations and revised the manpower requirements by problem areas. Recommendations were:

<u>Research Problem Area</u>	<u>Recommended SMY's - 1977</u>
RPA 703	68
RPA 704	35
RPA 708	294

The Southern Regional Research Committee considered manpower recommendation for the above RPA's. Their suggestions were subsequently revised by the Directors of Agricultural Experiment Stations in the Southern Region. The present Task Force, in reviewing projections made several years ago and actual inputs since that time, recognize progress in moving toward anticipated manpower needs. The comparison of SMY's in 1968, projected needs in 1977 and actual SMY's in 1975 are summarized by RPA's in the following table.

<u>Research Problem Area</u>	<u>1968</u>	<u>SMY's 1977 Projected</u>	<u>1975 Actual</u>
703	3.3	12.9	15.6
704	2.4	7.1	4.9
708	<u>25.0</u>	<u>42.9</u>	<u>30.3</u>
Total	30.7	62.9	50.8

Since the several national studies and the initial regional task force report for the region, the land-grant institutions of 1890 have received research support and have made significant inputs into food and nutrition. The above table includes the manpower from the 1890 institutions in the region; the following table summarizes the distribution of total effort between the 1890 and the 1862 institutions.

<u>Research Problem Area</u>	<u>SMY's in 1975</u>		
	<u>1862</u>	<u>1890</u>	<u>Total</u>
703	9.2	6.4	15.6
704	3.9	1.0	4.9
708	<u>23.8</u>	<u>6.5</u>	<u>30.3</u>
Totals	36.9	13.9	50.8

Research in food and nutrition cuts across many areas. In many cases projects are classified, apparently under two or more R.P.A.'s. In reviewing research in progress related to food and nutrition, particularly product oriented research, the task force identified considerable work under R.P.A.'s other than those usually considered food and nutrition. The following table summarizes by R.P.A. work which relates to food and nutrition.

<u>Research Problem Area</u>	<u>SMY's 1974 Actual</u>
402 Production of Fruit and Vegetable Crops	
with Improved Acceptability	6.4
403 New and Improved Fruit and Vegetable	
Products and By-Products	31.3
404 Quality Maintenance in Storing and Market-	
ing Fruits and Vegetables	11.6
405 Production of Field Crops with Improved	
Acceptability	4.1
406 New and Improved Food Products From Field Crops	5.8
409 Production of Animal Products with Improved	
Acceptability	11.0
410 New and Improved Meat, Milk, Eggs and	
Other Animal Food Products	<u>28.1</u>
Total	98.3

Examination of the data in the 700 RPA's indicate clearly that most of the SMY increase for these research areas has come from the 1890 institutions. There have been some increases in SMY's from the 1862 institutions, but these increases have not approached the projections for 1977.

The Task Force recognizes the need for additional personnel, but also recognizes the difficult economic environment and that all other research groups desire and recommend additional resources, both personnel and funding. The following recommendations are made for the research in foods and nutrition in the region:

Research Problem Area	SMY's		
	Actual 1975	Recommended 1980	1985
703	15.6	22.0	25.0
704	4.9	10.0	15.0
708	<u>30.3</u>	<u>40.0</u>	<u>45.0</u>
Total	50.8	72.0	85.0

SUMMARY OF RECOMMENDATIONS

The task force considered the multiple needs of the region and the requirements in terms of research to solve the myriad of problems confronting the region. While numerous recommendations have been made throughout the report, the task force recognized that not all problems can be attacked at one time. After considering the urgency of the several problem areas, the following priorities were established:

1. Increase substantially the manpower for research in human nutrition and food service systems.

2. Improve substantially research of a fundamental nature in human nutrition.
3. Improve and develop further research to evaluate present and potential intervention programs and nutritional needs of risk groups in the region.
4. Coordinate the research in human nutrition with the development of new food products.
5. Increase support for research in the consumer aspects of food and in food service systems.
6. Initiate multi-disciplinary research on the etiology of food practices and nutritional problems of cultural groups in the region.



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